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ABSTRACT

Data were collected from grades 3 to 8 students (N=377) in order to identify the determinants of their intentions to perform laboratory and non-laboratory science activities. Fishbein and Ajzen's Theory of Reasoned Action was used as the basis for the study. The theory posits that the immediate determinant of behavior is intention. Intention is determined by the weighted attitude toward the behavior and the weighted subjective norm. Attitude toward behavior and subjective norm are determined by combinations of beliefs, evaluations, and motivations to comply. Cores of salient beliefs related to attitude toward laboratory and non-laboratory behaviors and cores of salient beliefs related to subjective norm for laboratory and non-laboratory behaviors were identified. Hypotheses generated from the theory were confirmed. Attitude toward behavior and subjective norm explained significant amounts of variance in behavioral intention for both laboratory and non-laboratory behaviors. Attitude toward behavior had a greater relative weight than subjective norm for both laboratory and non-laboratory. The correlations between adjacent constructs in the theoretical model were significant in all cases. (Author)

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The Determinants of Grades 3 to 8 Students' Intentions to Engage in Laboratory and Non-Laboratory Science Learning Behavior

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Running Head: DETERMINANTS OF INTENTION

SE 050 485

Abstract

Data were collected from grades 3 to 8 students (N=377) in order to identify the determinants of their intentions to perform laboratory and non-laboratory science activities. Fishbein and Ajzen's Theory of Reasoned Action was used as the basis for the study. The theory posits that the immediate determinant of behavior is intention. Intention is determined by the weighted attitude toward the behavior and the weighted subjective norm. Attitude toward behavior and subjective norm are determined by combinations of beliefs, evaluations, and motivations to comply. Cores of salient beliefs related to attitude toward laboratory and non-laboratory behaviors and cores of salient beliefs related to subjective norm for laboratory and non-laboratory behaviors were identified. Hypotheses generated from the theory were confirmed. Attitude toward behavior and subjective norm explained significant amounts of variance in behavioral intention for both laboratory and non-laboratory behaviors. Attitude toward behavior had a greater relative weight than subjective norm for both laboratory and non-laboratory. The correlations between adjacent constructs in the theoretical model were significant in all cases.

The purpose of this study was to gain information about the determinants of student behavior with respect to laboratory and non-laboratory science learning activities. More specifically, the purpose of the study was to answer the following questions by using the Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980): (1) What are the salient beliefs of students with respect to engaging in laboratory and non-laboratory activities?, (2) What are the correlations between adjacent components in the Theory of Reasoned Action?, and (3) What are the relative weights of the immediate determinants (i.e., attitude toward the behavior and subjective norm) of student intention to engage in science learning behaviors?

Rationale for the Study

It appears that today's science educators do not have a clear idea or sufficient information regarding the determinants of children's intentions to engage in science learning behavior. Therefore, potentially effective approaches to attitude and behavior change in science education are not adequately informed. Knowledge of the determinants of science learners' behavior would inform science educators as to how they might better ensure that young people will participate in science activities. More

relevant and controlled experiments could be conducted after needed baseline information is collected.

Various authors (Haladyna, Olsen, & Shaughnessy, 1983; Koballa & Crawley, 1985; Linn, 1987; Zeidler, 1984) have recently called for sound, theoretical approaches to science education research, particularly in the area of attitudes. Such approaches are the ones most likely to make a significant and positive impact on learner behaviors. Along this line of thought, it is reasonable to assume that an understanding of the determinants of science learning behaviors is needed in order to develop an effective plan for changing the target behaviors.

Theory of Reasoned Action

There is substantial evidence to suggest that the construct most closely associated with behavior is behavioral intention (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Fishbein and Ajzen have developed the Theory of Reasoned Action which deals with behavioral intention and its determinants. The theory has recently generated considerable discussion among science educators (National Association for Research in Science Teaching, 1988) and has made its debut as a tool for use in science education research (Koballa, 1986, 1988; Stead, 1985).

The Theory of Reasoned Action is founded on the assumption that most socially relevant actions are under volitional control, and a person's intention to perform a behavior is the immediate determinant of the action (Ajzen & Fishbein, 1980). The paradigm's main use is the prediction and understanding of

behavior and its determinants. It is theorized " . . . that people use the information available to them in a reasonable manner to arrive at their decisions" (Ajzen & Fishbein, 1980, p. 244) regarding particular behaviors. The information a person has serves as the basis of his or her beliefs.

The model can be represented diagrammatically by Figure 1 (in the Appendix). Using the model, it is supposed that the intention (BI) to perform a certain behavior (B) is a function of the weighted (w_1) attitude toward performing a behavior (A_b) and the weighted (w_2) subjective norm (SN). Ergo, a behavioral intention consists of a personal and social component. Attitude toward the behavior is the individual's feelings about performing the behavior. It is a function of the beliefs (b) about expected consequences or outcomes of the behavior and the evaluations (e) of these outcomes. Attitude toward behavior can be measured directly by asking the person to rate the performance of the behavior on a scale, or it can be measured indirectly by summing salient attitudinal belief scores (i.e., b*e scores). Subjective norm is the person's perception of the pressures by important others, or referents, to perform the specific behavior. It is a function of normative beliefs (nb), or who might want them to perform the behavior, and the motivations to comply (mc) with the referents. Subjective norm can be measured directly, or indirectly by summing salient normative belief scores (i.e., nb*mc scores). The Theory of Reasoned Action also includes the construct of external variables (e.g., personality traits or

demographic variables). According to the theory, external variables are related to behavior only if they are related to one or more of the variables within the theory (Ajzen & Fishbein, 1980).

The Theory of Reasoned Action has been used to investigate a wide variety of human behaviors (Bowman & Fishbein, 1978; Hom & Hulin, 1981; Koballa, 1986, 1988; Lin, 1987; Riddle, 1980; Stead, 1985). The theory might also be successfully used to generate valid and reliable baseline information and understanding concerning the determinants of children's intentions to engage in science learning behaviors. Knowledge and understanding of young students is particularly important because many lose interest in science or their positive perceptions of science degenerate during grades 4 to 8 (Linn, 1987; Yager & Penick, 1986). In a similar vein, Talton and Simpson (1986) pointed out that "As more is understood concerning how adolescent students form attitudes toward science, policy changes can be made that will affect curriculum and instruction in science in American schools" (p. 366). Science educators need information that would be useful in changing science learners' ideas (Linn, 1987). The procured baseline knowledge and understanding related to science learning behavior could then be used to develop and execute experimental research and plan changes in educational practice.

Method

Baseline information was generated in this exploratory study and correlational analysis procedures were employed. The study progressed in three stages. Stage I involved (1) the selection of students, (2) elicitation session interviews with students, and (3) the construction of the instruments. Stage II was a pilot study including (1) the development of procedures for administering the instruments and (2) review or revision of procedures and instruments after collecting data from a sample of students. Stage III involved (1) the administration of the final instruments and (2) the analysis of data.

Population and Sample

The population consisted of grades 3 to 8 public school children in the mid-Willamette Valley region of Oregon. Three school districts were chosen to represent a variety of students in terms of demographic characteristics. Random selection via multistage cluster sampling (Borg & Gall, 1983) was used to select the 18 classes of students that were used in the study and the 6 classes that were included in the pilot study.

Sampling was executed such that 187 subjects were used for the laboratory behavioral intention and 190 subjects were used for the non-laboratory behavioral intention. About 20% (n = 72) of the students used in Stage III were randomly selected and interviewed in Stage I in order to elicit their salient attitudinal and normative beliefs. A completely separate group of classes and students was randomly selected from the involved

schools for the pilot study. The pilot study involved 102 students (55 in the laboratory group and 47 in the non-laboratory group). Students who were visually, hearing, or emotionally handicapped were not included in the interviews nor in the final data analysis.

Instrumentation

The behavioral intention items for laboratory and non-laboratory were worded with special attention given to the elements of action, target, context, and time (Fishbein & Ajzen, 1975). It was decided that stating a time frame (e.g., in the next two weeks) was unnecessary and would unduly complicate the behavioral statement for the young subjects. The behavioral intention item for laboratory was stated as follows:

> I plan to do the science projects and science experiments my teacher asks me to do.

The behavioral intention item for non-laboratory was stated as follows:

> I plan to do the science reading and science writing my teacher asks me to do.

A protocol was designed (according to Ajzen & Fishbein, 1980, Appendix A) for elicitation sessions with a subsample of the students. The sessions and questions were designed to elicit salient beliefs with respect to attitude toward the behaviors and subjective norm. The resultant responses were used to identify the modal salient beliefs. The "modal salient beliefs can be ascertained by eliciting beliefs from a representative sample of

the population; the beliefs most frequently elicited by [sic] this sample constitute the modal set for the population in question" (Ajzen & Fishbein, 1980, p. 68). Salient outcomes and salient referents (viz., beliefs that were relevant to the previously defined intentions) were elicited from a representative sample of students by basically following the protocol given by Ajzen and Fishbein (1980). The subsample students were asked to verbalize a list of positive outcomes or consequences and negative outcomes or consequences of engaging in laboratory or non-laboratory activities. The same subjects were asked to verbalize a list of significant others who might have expectations about whether or not they should engage in the learning behaviors. The researcher wrote down all responses of the interviewees while the sessions were being audiotaped.

The salient beliefs of the students were coded, from which a frequency listing was constructed. The first step was analogous to "a content analysis of the various beliefs emitted by different individuals" (Ajzen & Fishbein, 1980, p. 68). The responses were organized by grouping together beliefs that referred to similar outcomes and counting the frequency with which each outcome in a group was elicited. The researcher decided whether to consider the outcomes in a given group as a single belief or as separate beliefs, as suggested by Ajzen and Fishbein (1980). A final decision was made concerning which beliefs to include in the modal salient set. "Perhaps the least arbitrary decision rule is to choose as many beliefs as necessary

to account for a certain percentage (e.g., 75%) of all beliefs emitted" (Ajzen & Fishbein, 1980, p. 70). This method would have prevented a limited number of verbose subjects from dominating which beliefs were incorporated into the instrument. The criterion of 75% was used for this study.

The behavioral beliefs, outcome evaluations, normative beliefs, and motivation to comply items for the instrument were defined based upon the results of the elicitation sessions and analysis previously described. The item construction pattern that was delineated by Ajzen and Fishbein (1980) was followed. Both instruments consisted of seven subcomponents. Each subcomponent consisted of from 1 to 11 items. Each of the seven subcomponents could not necessarily be considered a subtest because the items in some of the subcomponents of the instrument were not homogeneous.

The predictive items were measured on five-point semantic differential scales. Except for the motivation to comply scales, which were scored from +1 (no) to +5 (yes), all scales were scored from -2 (e.g., bad) to +2 (e.g., good). Five response options (as used by Stead, 1985), rather than seven (as suggested by Ajzen and Fishbein, 1980), were used so that there would be fewer vague options for the young students.

Validity was assured via careful adherence to the Theory of Reasoned Action model and the instrument construction procedures proposed by the theory's authors. The content validity of the

item scales was also evidenced by their correspondence with the behavioral criteria.

Self-report instruments, such as those used in this study, are consistent with the model. The self-report instrument is a common and useful means of measuring subjects' affect. An assumption of this study was that the subjects were willing and able to report accurately on the concepts represented by the items on the instruments (Gronlund, 1981).

The readability of the instrument was ascertained via the Fry method (Minnesota Educational Computing Consortium, 1982; Klare, 1974-1975). The instrument probably could not have been written at the individual level of every student in the study (Herber, 1978). Therefore, the relatively arbitrary grade level of 5 was used for the pilot study. If the readability were rated above grade 5 for the initial instrument, an attempt would be made to alter it accordingly to assure that the vast majority of students could read it. The instruments were altered and simplified until the laboratory instrument was rated at the Fry grade level of 6 and the non-laboratory instrument was rated at the Fry grade level of 4. The researcher judged that the instruments could not be further simplified in terms of readability without straying too far from the protocol prescribed by the authors of the Theory of Reasoned Action. The two instruments differed in their readability mainly due to the words that were different in the two instruments; these words were essential to the nature of the two instruments.

Pilot Study

A pilot study (Stage II) was conducted during which procedures for administration of the instrument were developed. The instruments were read aloud to the students, feedback was elicited from the students concerning their understanding of the instruments, and the researcher and assistant reviewed the administration procedures. The researcher decided to use the instruments as first constructed and to read them aloud to all students.

Data Collection

Students were randomly assigned to the laboratory and non-laboratory groups and the researcher and assistant were randomly assigned to different groups for instrument administration. Those students who participated in the elicitation sessions also participated in the final administration of the instruments. The teacher was asked to go somewhere away from either half of the students; all teachers readily cooperated. The instruments were administered to 377 students during the period of November 2 through 5, 1987.

Data Analysis

The data analysis followed the pattern suggested by the authors of the Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). Multiple regression was used with behavioral intention as the dependent variable and attitude toward behavior and subjective norm as the independent variables. Standardized regression coefficients were calculated (Neter,

Wasserman, & Kutner, 1983) to represent the relative weights of attitude toward behavior and subjective norm under various conditions. Pearson product-moment correlation coefficients were used to develop a correlation matrix including the variables of behavioral intention, attitude toward behavior, subjective norm, sum of salient attitudinal beliefs, and sum of salient normative beliefs. An alpha level of .10 was used for the statistical tests. This level of significance was used since the nature of this study was exploratory, and use of such an alpha level made it more likely that a potentially important difference or relationship was not overlooked (Borg & Gall, 1983). Accumulated error rate comes to bear (Good, 1984) since several significance test were conducted. However, the reader is reminded that this research was exploratory and not involved in evaluating treatments. Therefore, the accumulated error rate associated with multiple hypothesis testing was not of major concern in this study.

Findings

The two major areas of exploration in this study were (1) the beliefs of students which determine attitude toward behavior and subjective norm regarding laboratory and non-laboratory science activities and (2) the relationship between variables in the Theory of Reasoned Action for laboratory and non-laboratory science activities.

Salient Beliefs

The students' modal salient attitudinal beliefs with respect to science projects and experiments (laboratory), and their respective frequencies of emission, are presented in Table 1 (in the Appendix). The students' modal salient normative beliefs (for laboratory) and their respective frequencies of emission are presented in Table 2 (in the Appendix). The students' modal salient attitudinal beliefs with respect to science reading and science writing (non-laboratory), and their respective frequencies of emission, are presented in Table 3 (in the Appendix). The students' modal salient normative beliefs (for non-laboratory) and their respective frequencies of emission are presented in Table 4 (in the Appendix). Although beliefs 1 to 5 alone would have accounted for at least 75% of all responses, the decision was made to include beliefs 6 and 7. Beliefs 6 and 7 were included because they had relatively high frequencies and they were identical to two of the beliefs included for the laboratory behavioral intention. Thus, more detailed comparison data could be obtained in the study by including beliefs 6 and 7.

Relationships Between Constructs in the Theory of Reasoned Action

Quantitative representations of the relationships between the model's constructs for laboratory behavior are presented in Figure 2 (in the Appendix). With behavioral intention as the dependent variable and attitude toward behavior and subjective norm as independent variables, the adjusted coefficient of multiple determination ($R^2 = .14$) is significant, $F(2, 184) =$

16.78, $p = .00$. The standardized regression coefficient (relative weight, w_1) of the attitude toward behavior is .35. The standardized regression coefficient (relative weight, w_2) of the subjective norm is .11.

Quantitative representations of the relationships between the model's constructs for non-laboratory behavior are presented in Figure 3 (in the Appendix). With behavioral intention as the dependent variable and attitude toward behavior and subjective norm as independent variables, the adjusted coefficient of multiple determination ($R^2 = .25$) is significant, F (2, 187) = 32.90, $n = 190$, $p = .00$. The standardized regression coefficient (relative weight, w_1) of the attitude toward behavior is .54. The standardized regression coefficient (relative weight, w_2) of the subjective norm is .08.

Discussion

The Theory of Reasoned Action was useful in identifying beliefs which are theoretically the determinants of intention and behavior with respect to science learning behaviors. Six of the beliefs about outcomes of doing laboratory science (e.g., cause of learning, cause of having fun) were identical or very similar to beliefs about outcomes of doing non-laboratory science. The six normative beliefs for laboratory (e.g., parents, teacher) were included in the seven for non-laboratory. Furthermore, correlations between the theory's constructs were significant.

Research Implications

The cores of salient beliefs should continually be focused upon by future researchers who are ultimately interested in affecting science learners' behaviors. This is true if one accepts the argument " . . . that a person's attitude toward a behavior is determined by the set of salient beliefs he holds about performing the behavior" (Ajzen & Fishbein, 1980, p. 65), and that attitude toward behavior is a major immediate determinant of intention, which is in turn the most immediate determinant of behavior (Fishbein & Ajzen, 1975). Thus, the present study has provided meaningful baseline information regarding the beliefs of grades 3 to 8 students with regard to performing laboratory and non-laboratory science learning activities.

It might be informative to perform a detailed analysis of the students' behavioral and normative beliefs. Such an analysis might reveal that subsets of them account for the majority of variance in the two major constructs, attitude toward behavior and subjective norm. If so, future experimental research could more efficiently focus on fewer beliefs in order to influence behavior.

Although attitude toward behavior and subjective norm predicted significant amounts of variance in intention, the amounts of variance explained in this study were not as great as in several other investigations which utilized the Theory of

Reasoned Action (e.g., Bowman & Fishbein, 1978; Hom & Hulin, 1981; Koballa, 1986, 1988; Lin, 1987; Riddle, 1980; Stead, 1985). Several things might account for the relatively low amount of variance explained. First, the researcher could not find other studies involving the Theory of Reasoned Action and subjects as young as most of those in the present study. It may be that the theory is not as helpful in explaining and predicting the intentions of such young people as it is for older people who might perceive that more behavior is under their own control. Second, a subjective analysis of the data suggested that subjects had a fairly high intention to engage in the behaviors in question. It is a fact that in general the more homogeneous the group, the lower the correlation. The apparently high intention may be due to these young students not perceiving the particular behaviors to be under their volitional control. A basic assumption of the Theory of Reasoned Action is that the behavior is under volitional control (Ajzen & Fishbein, 1980). A cursory look at the data also suggests that the homogeneity of intention was reduced at the higher grade levels. A further study may analyze whether there is a relationship between external variables (e.g., grade level and gender) and the determinants of intentions with regard to laboratory and non-laboratory science. Third, it may be that intention might have been better predicted for this group of subjects (or for any other group) by considering at least a third major determinant of intention. In this vein, the theory is constantly under revision (Ajzen &

Fishbein, 1980), and one revision has already been tested (Ajzen & Madden, 1986). Ajzen and Madden tested their "theory of planned behavior" in which perceived behavioral control was added as a third determinant of intention. Addition of the third construct greatly improved the prediction of behavioral intention. Perhaps addition of the perceived behavioral control construct would make the prediction of children's intention to engage in science activities more robust.

Consistent with the majority of other research that has employed Fishbein and Ajzen's model, attitude toward behavior had a greater relative weight than subjective norm in terms of predicting behavioral intention for both laboratory and non-laboratory behavioral intentions. Thus, it appears that attitude toward behavior lends more to the understanding of the determinants of science learning behavioral intention than does subjective norm for these grades 3 to 8 students.

Pedagogical Implications

This study has contributed baseline data regarding the determinants of young science learners' behaviors. Teachers of science, while working with children, might give special consideration to the cores of salient beliefs that this study discovered. However, one study using the Theory of Reasoned Action cannot be definitive and final concerning the determinants of children's intentions to engage in science learning activities. Further investigations of salient beliefs of grades

3 to 8 students would be helpful in reaching the major goals of science education.

Conclusion

Fishbein and Ajzen's (1975) Theory of Reasoned Action has been effective in exploring the determinants of young science learners' intentions to engage in laboratory and non-laboratory science activities. The research questions were answered and two major findings resulted from the application of hypotheses derived from the Theory of Reasoned Action. First, definable cores of salient beliefs, related to science learning behaviors, of grades 3 to 8 children were elicited and were significantly correlated with students' attitude toward behavior and subjective norm. Second, the behavioral intentions of the students were predictable based upon their attitude toward behavior and subjective norm. These findings are significant in terms of understanding and predicting children's intentions to engage in science learning behaviors. Such understanding and predictive ability might one day assist in planning ways to effectively alter young students' science learning behaviors.

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Appendix

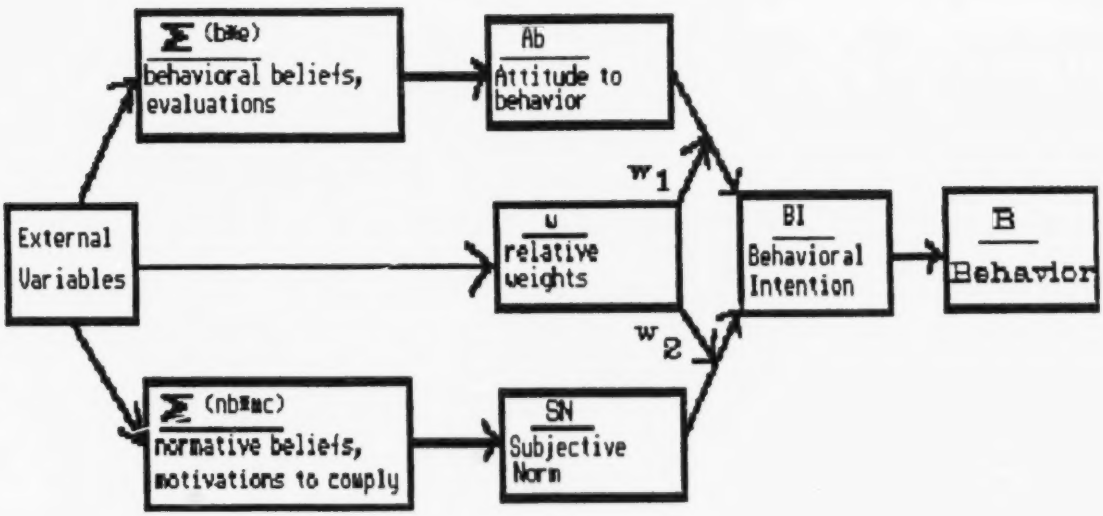

Figure 1. Fishbein and Ajzen's Theory of Reasoned Action

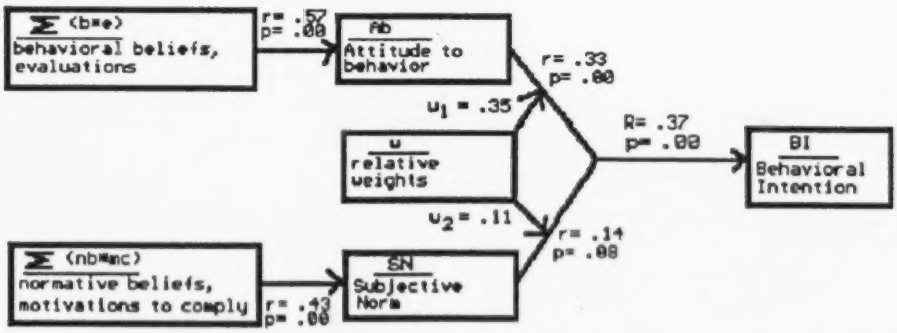

Figure 2. Relationships between constructs for laboratory behavior (n= 154).

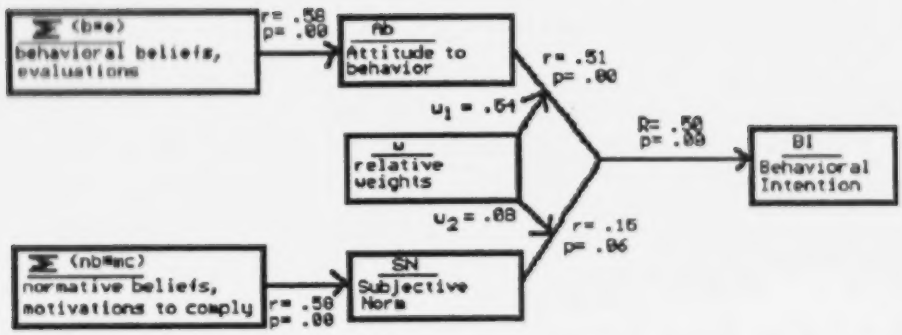

Figure 3. Relationships between constructs for non-laboratory behavior (n= 164).

Table 1

Modal Salient Behavioral Beliefs for Laboratory

Number	BELIEF that Doing Science Projects and Science Experiments:	Freq.	%	Cum. %
1	causes me to learn	31	19.6	19.6
2	causes me to have fun with science and enjoy science	21	13.3	32.9
3	allows me to do science activities and experiments	12	7.6	40.5
4	causes me to get good or better grades	11	7.0	47.5
5	causes me to have to do work on science assignments	11	7.0	54.4
6	causes me to be confused and not understand science	8	5.1	59.5
7	causes me to think of how a science experiment will turn out	7	4.4	63.9
8	causes me to be interested and not bored	7	4.4	68.4
9	causes me to have an experiment work well	6	3.8	72.2
10	causes me to dissect animals and touch their parts	6	3.8	75.9
11	causes dangerous things to happen	6	3.8	79.7
	various idiosyncratic beliefs	32	20.2	100.0
	Total	158		

Table 2

Modal Salient Normative Beliefs for Laboratory

Number	Normative BELIEF (or Referent)	Freq.	%	Cum. %
1	parents	41	37.3	37.3
2	teacher	18	16.4	53.6
3	brothers or sisters	8	7.3	60.9
4	grandparents	7	6.4	67.3
5	friends	7	6.4	73.6
6	God	6	5.4	79.1
	various idiosyncratic beliefs	23	20.9	100.0
	Total	110		

Table 3

Modal Salient Behavioral Beliefs for Non-Laboratory

Number	BELIEF that Doing Science Reading and Science Writing:	Freq.	%	Cum. %
1	causes me to learn	22	19.5	19.5
2	causes me to have fun with science and enjoy science	17	15.0	34.5
3	allows me to become someone who uses science in their job	14	12.4	46.9
4	causes me to get good or better grades	10	8.8	55.8
5	causes me to think about science activities and experiments	9	8.0	63.7
6	causes me to do questions that are difficult and hard to understand	7	6.2	69.9
7	causes me to do more writing	6	5.3	75.2
8	causes me to have to do work on science assignments	6	5.3	80.5
	various idiosyncratic beliefs	22	19.5	100.0
	Total	113		

Table 4

Modal Salient Normative Beliefs for Non-Laboratory

Number	Normative BELIEF (or Referent)	Freq.	%	Cum. %
1	parents	36	37.1	37.1
2	teacher	12	12.4	49.5
3	grandparents	11	11.3	60.8
4	relatives	11	11.3	72.2
5	brothers or sisters	7	7.2	79.4
6	friends	5	5.2	84.5
7	God	5	5.2	89.7
	various idiosyncratic beliefs	10	10.3	100.0
	Total	97		